Technical Memorandum No. 2

Subject: Marin Municipal Water District Service Area Analysis

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Section 1 Introduction and Purpose

This Technical Memorandum is part of a feasibility study of satellite recycled water treatment as part of a regional water recycling analysis for the North Bay Watershed Association. The general analysis techniques, developed in Technical Memorandum #1 "Draft General Process and Distribution System Overview" dated May 2004 will be applied to the Marin Municipal Water District's (MMWD's) service area. The general analysis techniques and analyses described in Technical Memorandum #1 (hereinafter referred to as the General Criteria) are used to identify a range of candidate satellite treatment plant sites and compare the feasibility of these satellite systems to a centralized recycling system.

Section 2 Study Area Characteristics

2.1 General Hydrologic Overview

The MMWD Service Area, illustrated in Figure 1, generally includes eastern Marin County from the Golden Gate Bridge to approximately the urban limits of the City of Novato. The most prominent geologic feature in the study area is Mt. Tamalpias. Groundwater resources are not significant.

Water Supply: MMWD actively manages surface water resources from 50,000 acres of local watershed lands in the Mt. Tamalpias and West Marin basins. The MMWD drinking water supply from Mt. Tamalpias and West Marin within MMWD's watershed is excellent.[1]

Wastewater Discharge Issues: The San Francisco Bay Regional Water Quality Control Board has identified the majority of streams lower in the watershed, outside of the MMWD drinking water supply, as impaired for diazinon. This is generally the result of storm water runoff and storm drain discharges within the urbanized portions of the study area.[2] The study area drains to San Pablo Bay, Richardson's Bay and San Francisco Bay. These waters are listed for multiple contaminants including pesticides, exotic species, dioxin and furan compounds, mercury, nickel, selenium and PCBs[3]..

[1] Urban Water Supply Management Plan, Marin Municipal Water District, February 18, 2003.
[2] Phase 1 Executive Summary, North Bay Watershed Stewardship Plan. RMC, October 2003.
[3] Phase 1 Executive Summary, North Bay Watershed Stewardship Plan. RMC, October 2003.

Figure 1 MMWD Service Area

2.2 Land Use & Population Trends

The MMWD service area and Marin County is, in general, slow-growing as a result of both growth management policies and active land conservation efforts. Much of the County's western coast is held as a National Seashore; upland watershed resources are held by MMWD; in the eastern portion of the County there are a number of bayside parks and open space holdings. The County expects population to grow from approximately 230,000 people to 250,000 (an increase of 10%) as it moves to buildout. However, commercial and industrial square footage is expected to double as the County seeks to improve its jobs-to-housing balance.[4]

Growth will be concentrated within the existing urban areas. While the County is expected to grow by 10%, the population in MMWD's service area is closer to build-out, and is anticipated to grow by 7.5%.

2.3 Water Supply

MMWD's water supply is composed of local stored surface water (approximately 80,000 acre-feet annual average), imported water from Sonoma County Water Agency (approximately 8,000 acre-feet annual average) and recycled water produced in the northern part of its service area (approximately 800 acre-feet on annual average). MMWD also has an extensive water conservation program that has

[4] Marin Countywide Plan, Community Development Element, September 1999 amendments.

achieved a 25% reduction in demand through various measures.[5] The local surface water supply, in particular, is highly variable and MMWD experienced prolonged droughts in the late 1970s and early 1990s. In addition, Sonoma County Water Agency is currently engaged in a complex Endangered Species Act negotiation for its Russian River supply and has entered into a "Temporary Impairment Agreement" with its wholesale customers. MMWD's Urban Water Management Plan acknowledged a potential water supply deficit of 1,650 acre-feet annually in 2000 at current demands[6]. MMWD analyzed the feasibility of constructing a desalination plant along San Francisco Bay in the early 1990's. Because of improvements to membrane system efficiency and the potentially high variability in its source water supply, MMWD is revisiting this analysis and has begun scoping an environmental document. The desalinated water supply is estimated to cost $1,525 per acre-foot per year in current dollars.[7]

2.4 Wastewater Disposal

The MMWD Service area includes 14 wastewater agencies. Five of these agencies shown in bold face maintain treatment facilities, including two Title 22 tertiary water recycling facilities; eight of these agencies maintain only collection systems and 1 maintains a collection system and a water recycling facility that does not meet current Title 22 standards for filtration or disinfection. This water recycling facility, operated by Richardson Bay Sanitary District was "grandfathered" to allow it to continue its urban irrigation practice, and can not be expanded to serve additional users. Treated effluent is generally disposed of by outfall to San Pablo or San Francisco Bay. Shallow water discharges to San Pablo Bay are limited to the wet weather season, creating the need for some land-based disposal at the Las Gallinas Valley Sanitary District in the northern part of the service area. Table 1 below provides a summary of the wastewater agencies, listed from south to north.

[5] Urban Water Supply Management Plan, Marin Municipal Water District, February 18, 2003, page 6.
[6] Urban Water Supply Management Plan, page 29. "Deficit means that MMWD is relying more heavily on local surface water supplies which may not be sustainable under drought conditions."
[7] Seawater Desalination as Possible Alternative component of Integrated Water Resources for MMWD, June 2001, Bahman Sheikh in association with Parsons

Table 1 Summary of Wastewater Agencies

Agency	Facilities Maintained	Tributary To	Average Dry Weather Flow	Recycling Capacity	Other Disposal Methods
Sausalito Marin City Sanitary District (SMCSD) [1]	Collection & Treatment Facilities	N.A.	1.40 mgd	0	**San Francisco Bay Outfall**
Tamalpias CSD	Collection Facilities	SMCSD & SASM	0.36 mgd	0	N.A.
Sewerage Agency of Southern Marin (SASM) [2]	Treatment & Recycling Facilities	N.A.	2.90 mgd	0.18 mgd	**San Francisco Bay Outfall**
Richardson Bay Sanitary District	Collection & Recycling Facilities	SASM	not available	0.07 mgd	N.A.
Homestead Valley Sanitary District	Collection Facilities	SASM	0.18 mgd	0	N.A.
Alto Sanitary District	Collection Facilities	SASM	0.08 mgd	0	N.A.
Almonte Sanitary District	Collection Facilities	SASM	0.14 mgd	0	N.A.
City of Mill Valley	Collection Facilities	SASM		0	N.A.
Sanitary District No. 5	Collection & Treatment Facilities	N.A.	0.76 mgd	0	**San Francisco Bay Outfall**
Central Marin Sanitation Agency (CMSA) [1]	Treatment Facilities	N.A.	8-10 mgd	0	**San Francisco Bay Outfall**
Sanitary District No. 1	Collection Facilities	CMSA	3.00 mgd	0	N.A.
Sanitary District No. 2	Collection Facilities	CMSA	0.81 mgd	0	N.A.
San Rafael Sanitation District	Collection Facilities	CMSA	4.40 mgd	0	N.A.
Las Gallinas Valley Sanitary District (LGVSD)	Treatment & Collection Facilities	N.A.	2.20 mgd	2.0 mgd	**Shallow Water Discharge (Miller Creek), Land Application**

[1] TDS of effluent is too high to be used for landscape irrigation
[2] TDS of effluent is marginal for landscape irrigation
N.A. stands for Not Applicable

Section 3 Market Assessment Methodology

3.1 Relationship to Previous Studies

In the 1976-77 drought, MMWD began providing recycled water in its service area from a pilot facility. In 1981, MMWD brought online a 1 mgd recycled water facility, using effluent from the Las Gallinas Valley Sanitary District (LGVSD). This facility was expanded to 2 mgd in 1989. Since that time, MMWD has actively explored additional water recycling opportunities and the recycled water market within this service area is well understood. Recent market analyses completed within the service area include:

- The Recycled Water Expansion Feasibility Study, prepared by Marin Municipal Water District in January, 2000. This study explored additional development of recycled water from both the LGVSD and the Central Marin Sanitation Agency (CSMA).

- Review of Water Recycling and Gray Water, prepared by Bahman Sheik, Ph.D, P.E. with Parsons in April of 2001. This study reviewed the results of the Recycled Water Expansion Feasibility Study and introduced the concept of Satellite Water Recycling Facilities.
- North Bay Regional Water Recycling Feasibility Study, prepared by RMC in November of 2002. This study explored providing regional tertiary treatment for all five wastewater dischargers in the MMWD service area along with facilities that serve the City of Novato, the City of Petaluma and the Sonoma Valley Sanitation District.
- The SMCSD/Ft. Baker Recycled Water Feasibility Study, currently in draft by RMC. This study focuses specifically on the recycled water market at Ft. Baker at the Southern end of the MMWD Service Area.

Figure 2 illustrates the geographic area reviewed in each of the previous market analyses, as well as the service areas reviewed by this study.

This study, which focuses specifically on the feasibility of satellite facilities, included an analysis of the tributary collection systems in the MMWD service area in order to match wastewater flows with water demands. The analysis focuses on discrete clusters of users located some distance from the central wastewater treatment plant and begins by identifying a distant large water user and then identifying a nearby “sewershed” with adequate flow to serve the user.

3.2 Regulatory Context

All of the market analyses indicate that MMWD’s urban recycled water market will require Title 22 Disinfected Tertiary Recycled Water. Additional treatment to manage high salt content in the secondary effluent is considered in specific areas and is described in the Alternative Analysis section, below.

MMWD currently operates its recycled water facilities under permit from the San Francisco Bay Regional Water Quality Control Board (Region 2). Region 2 has implemented a General Water Recycling Permit. Public agencies may apply for coverage under the General Permit by filing a Notice of Intent together with an Engineer’s Report prepared in accordance with Title 22.

MMWD has a Recycled Water Mandatory Use Ordinance in place within its service area, assuring that available recycled water will be beneficially used. The Ordinance serves as evidence of potential user notification.

3.3 Water Demand and Costs

Water demand within the MMWD service area was quantified using MMWD’s user database. This database includes information on each users “entitlement”, which is the total capacity that user has purchased in the system. This analysis focuses primarily on irrigation demand and, as appropriate, the entitlement data has been reviewed with respect to water use records. As noted above, MMWD anticipates that cost of future water supply through desalination will be $1,525 acre-foot.

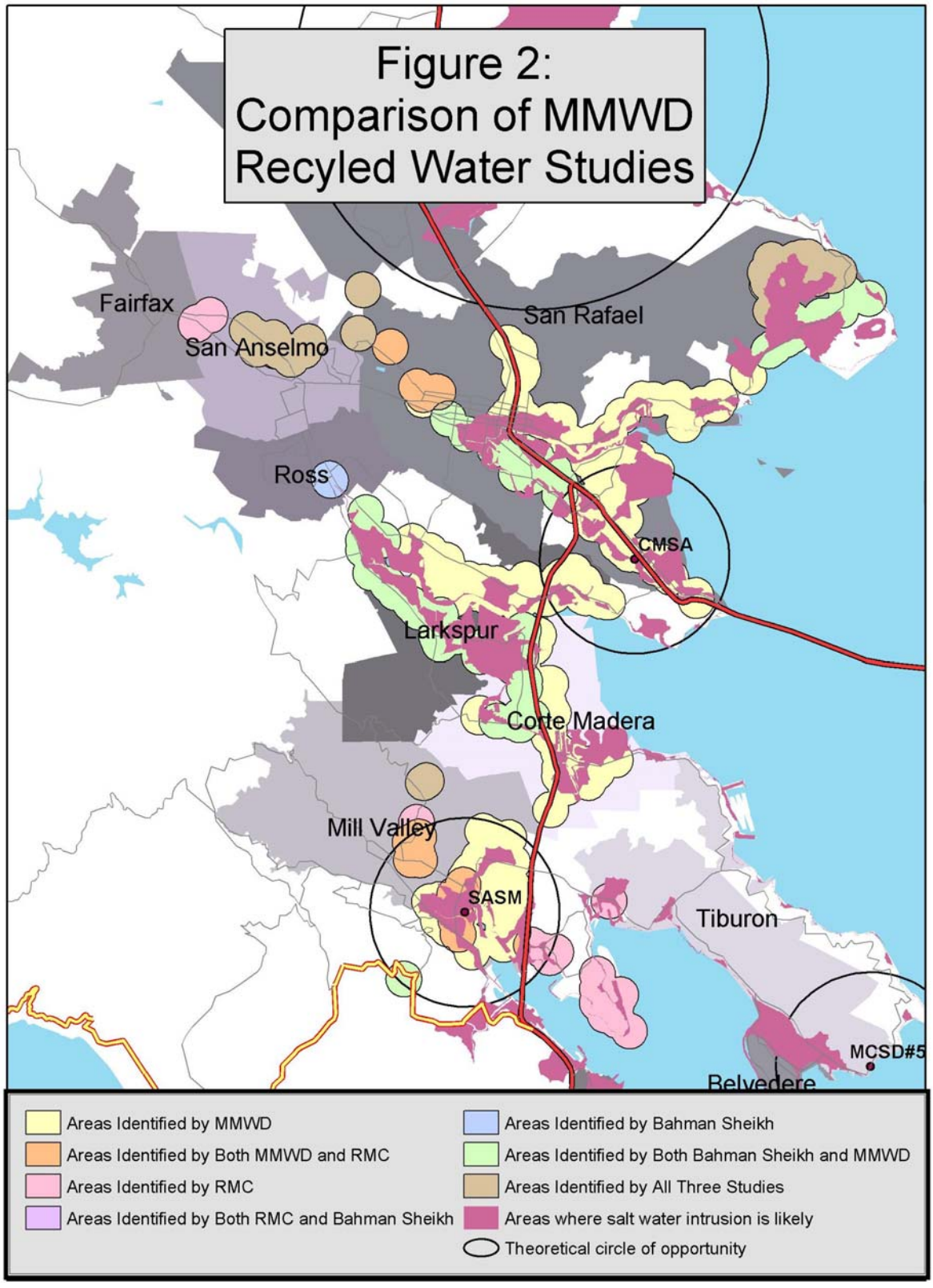

Figure 2 Comparison of MMWD Recycled Water Studies

Section 4 Alternatives Analyzed

4.1 No Project

Under the No Project Alternative, recycled water service is not expanded in the MMWD service area. MMWD would be limited to meeting approximately 2 mgd of its total demand with recycled water.[8] Future water supply will be provided by a desalination plant. Future water costs are $1,525 per acre foot in 2003 dollars. The No Project Alternative also does not provide any wastewater disposal benefits. All five dischargers would continue to meet their disposal needs through land application and/or outfalls to San Pablo and San Francisco Bays resulting in approximately 14 to 16 million gallons per day of discharge under average conditions.[9]

4.2 Assumptions Common to all Recycled Water Alternatives

All alternatives developed are located within the MMWD service area, although in different sanitary sewer service areas. Some common assumptions were made in order to produce a uniform analysis. These assumptions relate to:

- interpretation of water demand data;
- present and future water needs;
- quality (salinity), reliability and timing of water use;
- distance from the central wastewater treatment plant;
- availability of adequate sanitary sewer flow; and
- capital and operational costs.

4.2.1 Interpretation of Water Demand Data

In support of this study, MMWD provided water use data for all of its water customers. The most important data sets used for this study were called entitlement and estimated use. The entitlement is the amount of water that has been agreed upon for MMWD to supply to each user. It depends on each user's assumed water demand. The estimated use is an average of each customers actual metered water use which can vary significantly from entitlement.

These data sets were used in combination to estimate the costs of providing satellite recycled water treatment. The entitlement data was used first to help identify the large "anchor users" that may indicate a cluster of recycled water users that could feasibly be served by a satellite plant. In most cases, this entitlement data (provided in the unit of acre-feet per year) for an identified cluster was used to size the plant since it is important to have the capability to provide the quantity of water that has been promised to each user.

In many cases the estimated use data indicated that the anchor users were not in fact consuming the full amount of their entitlement. If any of the alternatives were to proceed forward into predesign, additional investigation would be needed to determine the best basis for process sizing, i.e. entitlement versus actual usage.

The cost per delivered acre-foot (or $/AF) is shown based on both the entitlement and the actual usage.

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[8] The Las Gallinas Water Recycling Facility has a capacity of 2 mgd.

[9] Marin Municipal Water District 2000 Urban Water Management Plan, February 18, 2003, pages 11 and 12

4.2.2 Present and Future Water Needs

As noted above, the MMWD service area is slow-growing and contains stable land uses. Each alternative developed is "anchored" on an existing urban irrigation use. Present and future water demands are estimated based on each individual's water entitlement from MMWD, as well as average annual water use, as provided by MMWD. Because of MMWD's mandatory use ordinance, it is assumed that recycled water use can begin as soon as the water is available.

The proposed water recycling facilities are sized to provide for the demand of the average day of the peak month of water use. It has been assumed that the peak monthly demand is approximately 18% of the total annual water demand, as shown in Figure 3. To determine the size of the plant, the total annual demand is multiplied by 18% to determine the total demand during the peak month. It is then divided by 30, to determine the average daily demand during the peak month. The plant is sized to provide for this demand.

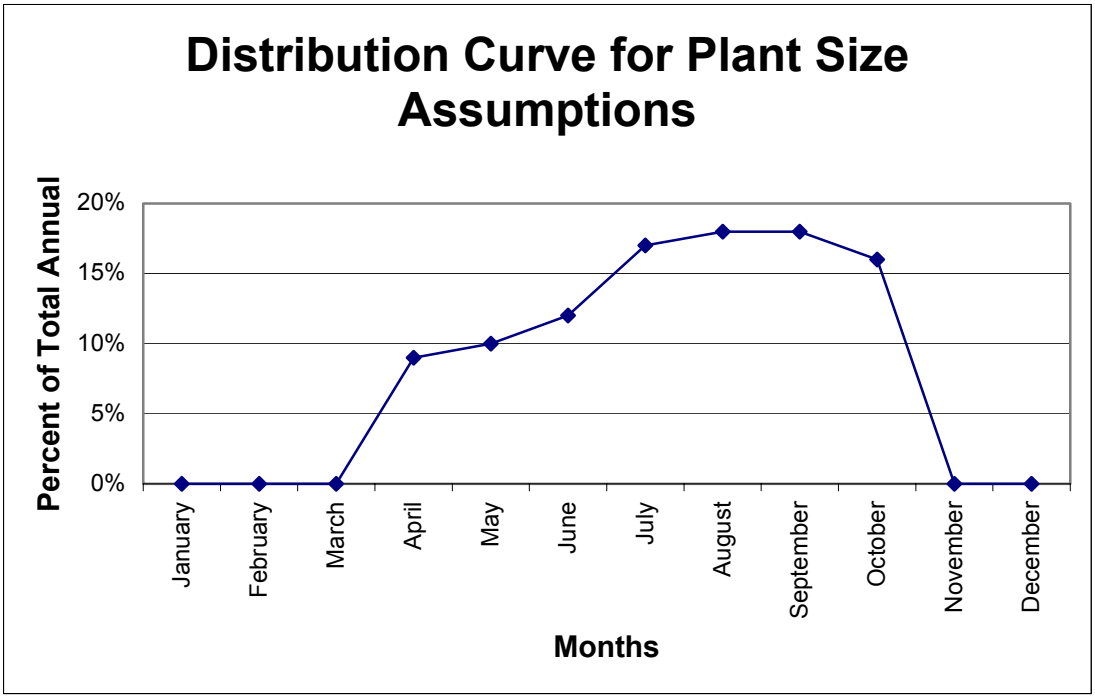


Figure 3 Distribution Curve for Plant Size Assumptions

4.2.3 Water Quality, Reliability and Delivery Timing

In accordance with the General Criteria outlined in Technical Memorandum #1, this analysis is based on supplying Disinfected Tertiary Recycled Water to the recycled water users. In addition, because most users are irrigation users, the study assumes that salt concentrations will be a limiting constituent in areas where the ground elevation is below 10 feet.[10] This analysis uses two methods of salt concentration management when recycled water facilities and/or their sewersheds are located below

[10] Data from SASM and the Central Marin Sanitation Agency Salt Water Reduction Study (CDM, 1993) both associate salt water infiltration with a 6-foot tide. This study assumes that sanitary sewers will have minimum depth of 4-feet, yielding potential saltwater intrusion problems in portions of sewer service area at elevation 10 or under.

this 10-foot elevation. These include adding reverse osmosis to the treatment process and blending with potable water to reduce concentrations.

In addition to the extra cost, the introduction of reverse osmosis to the centralized wastewater treatment plant takes away from the wastewater agencies' incentive to participate in recycling. In general, producing recycled water results lowers the mass of contaminants in a wastewater treatment plant's discharge. Reverse osmosis removes this benefit.

In accordance with the General Criteria, this analysis assumes that a potable water backup supply is available to provide adequate reliability to the user. In addition, and in accordance with the General Criteria, this study assumes that the satellite treatment plant includes a storage tank to manage potential discrepancies between wastewater flow and irrigation demand.

4.2.4 Distance from the Central Treatment Plant

The General Criteria suggested that users located outside a 4-mile distance from the central treatment plant might be cost-effectively served by a satellite water recycling facility. This analysis acknowledges that pipeline can rarely be placed on a straight radial alignment and uses a 2.5 mile radius to approximate a 4 mile distance along an alignment. This radius is reduced to approximately 1 mile if reverse osmosis treatment is required to improve the water quality from the central plant. This initial assumption has helped to focus the study on a reasonable range of customers to review.

4.2.5 Sanitary Sewer Flow

While all of the sewerage agencies located within the MMWD service area provided detailed mapping to assist in this analysis, none of the agencies had available flow data from their collection systems. Flow measurement was performed only at the treatment plant, not out in the collections system. Estimating sanitary sewer flow is an important part of satellite plant feasibility because, many times, the location and/or size of the plant is determined by how much wastewater is available at the site.

There were two methods used to estimate dry weather sewer flow. The first is an estimate based on water records. MMWD estimates that 40% of its annual water delivery goes to outdoor use.[11] It is estimated that another 5% goes to consumptive uses. Therefore, it was estimated that the sewer main will carry 55% of the average annual water use. The other way of estimating sewer flow was to use land use production assumptions outlined in Technical Memorandum #1. Marin County averages 2.25 people per residence.[12] This average was multiplied by the number of residential service connections in each area's sewershed and then by 75 gpd/person. In all cases, the latter estimating method proved more conservative (resulted in a lower estimated flow), so it was chosen as the method to estimate sewer flow.

4.2.6 Capital and Operational Costs

The General Criteria in Technical Memorandum #1 include cost curves for both satellite treatment facilities and central plant upgrades. These curves were used to develop the cost analysis for each alternative evaluated. The cost per acre foot calculation includes capital cost annualized over 30 years at an interest rate of 6% plus the annual O&M cost divided by the annual yield of the plant in acre feet. For more information on cost development, see Technical Memorandum #1.

[11] Personal Communication, Bob Castle, Water Quality Manager, Marin Municipal Water District.
[12] Marin Countywide Plan, Community Development Element, January 1994 with amendments as of September 1999

4.3 Sausalito Marin City Sanitation District (SMCSD) Service Area

4.3.1 Summary Market Analysis

The SMCSD Service Area includes the cities of Sausalito and Mill Valley, Tamalpais Valley, Muir Woods and Marin Headlands. Much of this service area is in public-trust holdings, primarily by the National Parks Service. Water use in the service area is modest. Review of water use records and personal conversations with utility system managers indicate that the primary new water demand is on Fort Baker, in the Marin Headlands, which is redeveloping for civilian use.

A Feasibility Study for siting a satellite plant at Fort Baker is currently underway by the National Park Service. The following summarizes that analysis. Analyses performed for the National Park Service indicates a potential demand of 98,700 gallons per day, or 55.4 AFY, as outlined in Table 2, below.

Table 2 Potential Water Demands at Fort Baker

Potential Recycled Water Use	Average Demand (AFY)
Fort Baker Irrigation	
Parade Grounds	29.3
Water Front Meadow	9.2
Other Landscape Restoration	8.5
Coast Guard Headquarters	1.7
Proposed Fort Baker Plan	
Toilet Flushing	4.0
Commercial Laundry	2.7
Totals	55.4

Demands from the National Park Service Fort Baker Feasibility Study, RMC April 2004

4.3.2 Sizing of Treatment Facilities

The National Parks Service is redeveloping Fort Baker with a goal of demonstrating sustainable development. To this end, they are working to match the recycled water use with the volume of wastewater generated on the facility. The Fort Baker Redevelopment is anticipated to generate 56,000 gpd of raw wastewater. Water recycling facilities will be sized for this influent flow. Landscaping design and irrigation practices will be modified to use only the volume of recycled water available.

4.3.3 Location of Treatment Facilities

The satellite facilities are proposed to be located on an abandoned building pad east of the Bay Area Discovery Museum. This is approximately 360 feet from the main irrigation use and approximately 3800 feet from SMCSD's main treatment facilities.

4.3.4 Salt Water Intrusion

The lower portions of SMCSD's service area are subject to salt water intrusion. Influent sampling confirms the need to utilize RO treatment on the effluent from the central plant. However, the sewershed on Fort Baker is not subject to salt water intrusion.

4.3.5 Comparative Cost Analysis

The preliminary analysis for the Fort Baker facility includes a capital cost of $5,200,000 for a central plant upgrade and $4,000,000 for a satellite treatment facility. Operational costs are estimated at $48,000 and $44,000 per year respectively. This corresponds to a satellite plant cost of $9,980/AF.

4.3.6 Implementation Considerations

The central SMCSD treatment facility is built essentially on a platform on the waterfront of San Francisco Bay. There is no space on the platform for additional treatment equipment necessary to provide Title 22 effluent suitable for irrigation or for the reverse osmosis process required for salt removal. The central site is surrounded by sensitive land uses and the nearest location to site additional treatment facilities is literally on Fort Baker. These fundamental site constraints, combined with NPS's stated desire to develop in a sustainable manner favor the satellite facility.

4.4 Sewerage Agency of Southern Marin (SASM) Service Area

4.4.1 Summary Market Analysis

The SASM Service Area includes the City of Mill Valley. In the analysis for siting a satellite plant, nine water users, including the Mill Valley Golf Course, were identified as possible candidates for satellite treatment. As with the satellite analysis in the other service areas, this alternative was compared with the alternative of building recycled water facilities at the central plant (which, in this case, would include reverse osmosis) and building a distribution system to serve this area.

Mill Valley Golf Course has wells that currently supplement the potable water they purchase from MMWD. This accounts for their relatively small entitlement (30 AF/yr) in comparison to other 9-hole golf courses. It is expected that if recycled water became available, the golf course would continue to irrigate with a combination of well water and purchased water.

Table 3 provides a listing of users and entitlements and their associated recycled water demand data. Figure 4 illustrates the location of the candidate users. The satellite users are located in the Buenavista/East Blithedale sewershed, approximately 2 miles from the central treatment plant.

Table 3 Water Demands in SASM Service Area

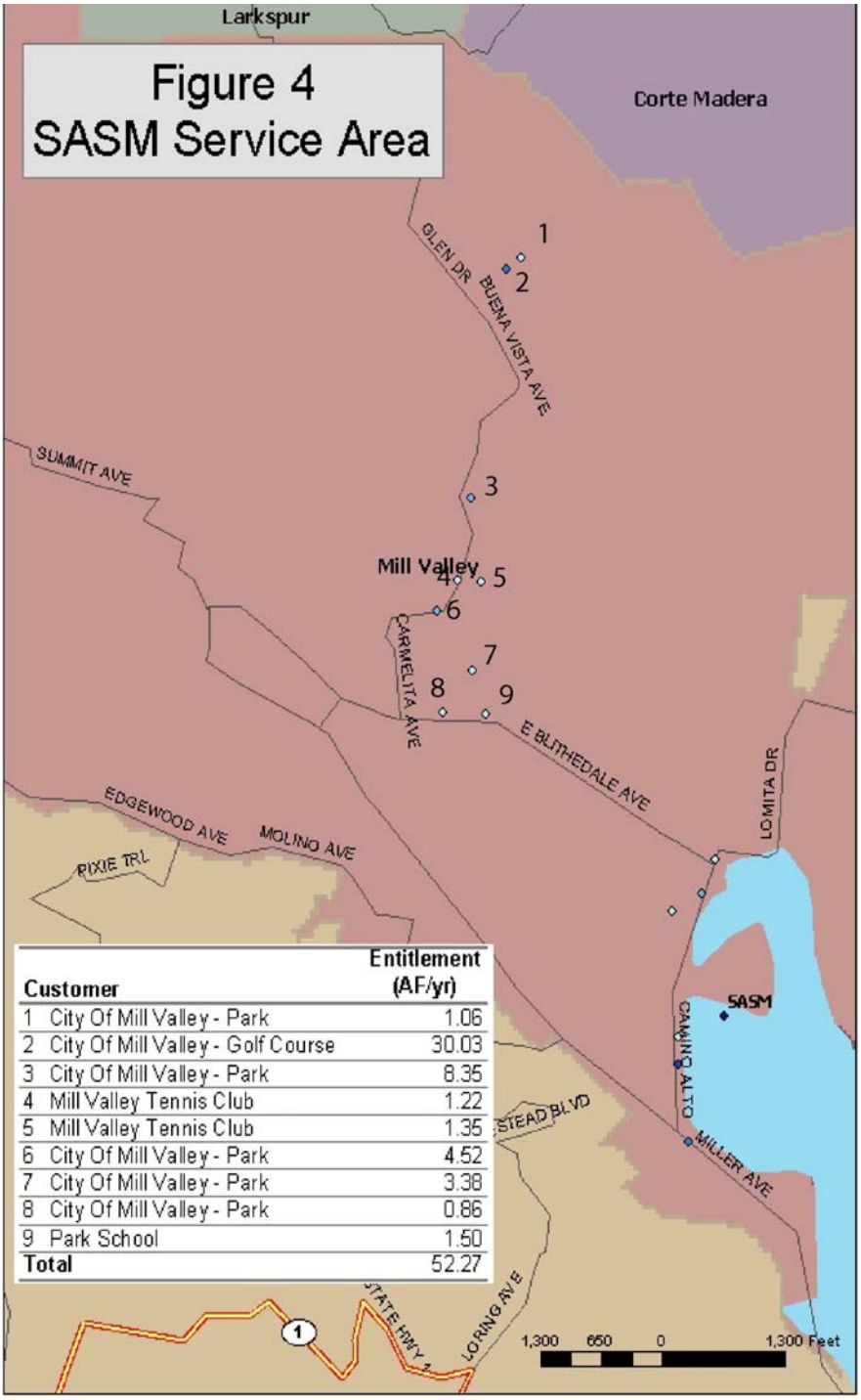
Customer	Entitlement (AF/yr)	Average Use (AF/yr)
Park School	1.50	0.41
Mill Valley Tennis Club	1.22	0.25
City Of Mill Valley - Park	8.35	8.35
City Of Mill Valley - Park	0.86	0.76
Mill Valley Tennis Club	1.35	0.84
City Of Mill Valley - Park	4.52	4.52
City Of Mill Valley - Park	3.38	3.38
City Of Mill Valley - Golf Course	30.03	30.03
City Of Mill Valley - Park	1.06	1.06
Total	**52.27**	**49.60**

4.4.2 Sizing of Treatment Facilities

Based on an entitlement of 52.27 AFY, the satellite service area demand can be met by a recycling facility with a capacity of 101,000 gallons per day, which is sufficient to meet the demand of the average day of the peak month. Note that for this service area, the average use of the customers was approximately 95% of the users' entitlements

4.4.3 Location of Treatment Facilities

The Buenavista/East Blithedale sewershed is a relatively small sewershed with less than 150 residential connections. In order to develop enough flow in the trunk sewer to support the recycled water demand, the satellite recycling facility needs to intercept flow near the intersection of East Blithedale and Camino Alto. This is approximately 8,000 feet from the Mill Valley Golf Course, the largest user in the satellite service area. It is approximately 2,500 feet from SASM's treatment plant.



Customer	Entitlement (AF/yr)
1 City Of Mill Valley - Park	1.06
2 City Of Mill Valley - Golf Course	30.03
3 City Of Mill Valley - Park	8.35
4 Mill Valley Tennis Club	1.22
5 Mill Valley Tennis Club	1.35
6 City Of Mill Valley - Park	4.52
7 City Of Mill Valley - Park	3.38
8 City Of Mill Valley - Park	0.86
9 Park School	1.50
Total	52.27

Figure 4 SASM Service Area

4.4.4 Salt Water Intrusion

The SASM service area includes low lying areas where salty groundwater infiltrates into the collection system. SASM currently blends potable water with their recycled water during certain tide cycles in order to deliver recycled water of acceptable quality.

4.4.5 Comparative Cost Analysis

This study develops two alternative cost scenarios for the SASM area. These include: (1) a 101,000 gpd Satellite Facility at the intersection of East Blithedale and Camino Alto; (2) a 101,000 gpd upgrade to the SASM facilities including reverse osmosis treatment for salt management. Table 4 presents these costs estimates. The calculation of $/AF is calculated using both the total acre-feet of water from the entitlement data as well as the estimated use data.

Table 4 Comparative Cost Analysis for SASM Area

	Alternative	Capital Cost	Annual O&M	Unit Cost $/AF (based on Entitlement)	Unit Cost $/AF (based on Estimated Usage)
1	101,000 gpd Satellite Facility	$3,820,000	$41,000	$6,140	$6,470
2	101,000 gpd upgrade to SASM (inc. RO)	$3,430,000	$228,000	$9,660	$9,910

4.4.6 Implementation Considerations

The satellite alternative is the most cost effective. The delivered water cost of $6,140/AF based on entitlement or $6,470/AF based on estimated usage are, respectively approximately $4,615/AF and $4,945/AF more than the next increment of potable water supply.

4.5 Richardson Bay Sanitary District (RBSD) Service Area

4.5.1 Summary Market Analysis

The RBSD Service Area includes Strawberry Peninsula and portions of the Tiburon Peninsula. Flows from RBSD are pumped to SASM for treatment and disposal. RBSD maintains a small effluent polishing plant that treats SASM's secondary effluent for irrigation use.

The was no anchor user or candidate cluster of users identified for satellite treatment in the RBSD Service Area so this area was determined to be infeasible for satellite treatment.

4.6 San Rafael Sanitation District

4.6.1 Summary Market Analysis

The most feasible location for a satellite plant in San Rafael is in the Peacock Gap area. There are 19 irrigation users in the Peacock Gap area that could be served with recycled water. The largest irrigation in the area is the Peacock Gap Golf Course. In total, the users in the area have a total entitlement of 248 acre-feet per year. The irrigation users are listed in Table 5 and their locations are shown in Figure 5.

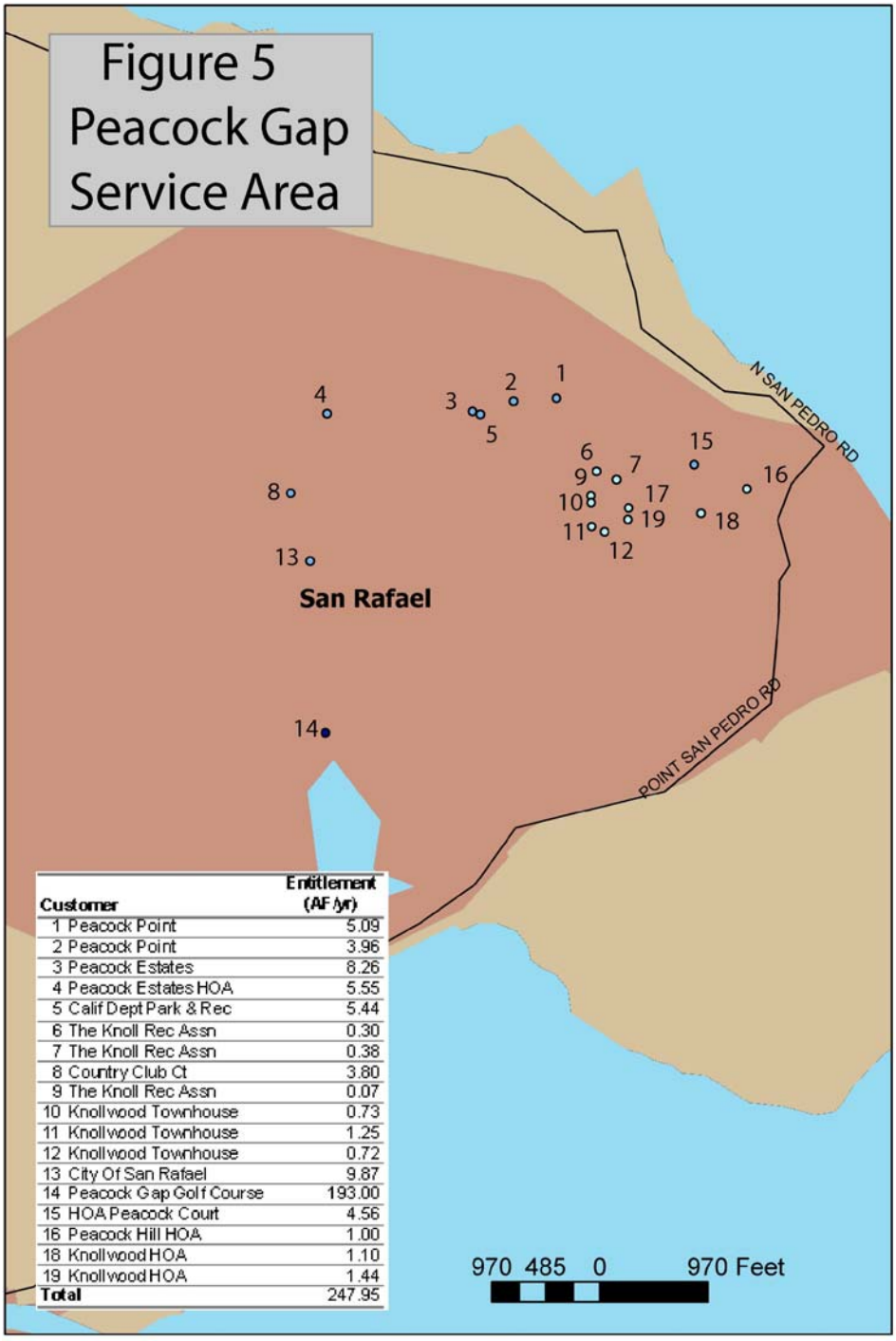
Table 5 Water Use in the Peacock Gap Area

Customer	Entitlement (AF/yr)	Average Use (AF/yr)
Peacock Gap Golf Course	193.00	114.00
Peacock Hill HOA	1.00	0.44
City Of San Rafael	1.43	1.43
The Knoll Rec Assn	0.07	0.07
Knollwood Townhouse	0.73	0.15
Knollwood Townhouse	1.25	0.25
Knollwood Townhouse	0.72	0.30
Knollwood HOA	1.10	0.31
Knollwood HOA	1.44	0.38
The Knoll Rec Assn	0.30	0.26
The Knoll Rec Assn	0.38	0.38
Calif Dept Park & Rec	5.44	1.47
Peacock Estates HOA	5.55	5.55
Peacock Estates	8.26	8.26
City Of San Rafael	9.87	9.87
Peacock Point	3.96	3.96
Peacock Point	5.09	5.09
HOA Peacock Court	4.56	4.56
Country Club Ct	3.80	3.80
Total	**247.95**	**160.53**

4.6.2 Sizing of Treatment Facilities

The satellite service area entitlement demand can be met with 480,000 gallons per day of irrigation water. However, the sewer main along Pt. San Pedro Road doesn't carry enough flow to supply a satellite plant of that size. A location was chosen in the sewershed that will supply enough wastewater for a 220,000 gpd plant. The recycled at this plant will be blended with potable water in order to serve all of the users listed above.

For this service area, the average use of the customers was approximately 65% of the users' entitlements. This disparity is mostly due to the fact that its anchor user (Peacock Gap Golf Course) only currently uses 60% of its entitlement. The total of all of the users' entitlements was used to determine the recycled water demand in the area.



Customer	Entitlement (AF/yr)
1 Peacock Point	5.09
2 Peacock Point	3.96
3 Peacock Estates	8.26
4 Peacock Estates HOA	5.55
5 Calif Dept Park & Rec	5.44
6 The Knoll Rec Assn	0.30
7 The Knoll Rec Assn	0.38
8 Country Club Ct	3.80
9 The Knoll Rec Assn	0.07
10 Knollwood Townhouse	0.73
11 Knollwood Townhouse	1.25
12 Knollwood Townhouse	0.72
13 City Of San Rafael	9.87
14 Peacock Gap Golf Course	193.00
15 HOA Peacock Court	4.56
16 Peacock Hill HOA	1.00
18 Knollwood HOA	1.10
19 Knollwood HOA	1.44
Total	247.95

Figure 5 Peacock Gap Service Area

4.6.3 Location of Treatment Facilities

The Peacock Gap area has a very small sewershed. The wastewater must be intercepted at Pt. San Pedro Rd. at Main Dr., a location approximately 4,200 feet away from Peacock Gap Golf Course, the area's anchor user. This location is approximately 20,000 feet from CMSA, the closest wastewater treatment plant. A distribution system of approximately 4,200 feet of pipe will be needed to serve the identified irrigation users.

4.6.4 Salt Water Intrusion

Much of the Peacock Gap area resides below the 10-foot elevation. It is expected that the wastewater in the sewer main will have a high salt content. Since the satellite plant will be creating less than half of the irrigation demand, it can be blended with potable water. In this case, the satellite plant won't require any additional unit processes to manage the salinity. This blending will create enough water to meet the recycled water demand at a tolerable salinity level.

4.6.5 Comparative Cost Analysis

This study compared the cost of a 220,000 gpd satellite facility with the cost of adding 480,000 gpd recycled water facilities including reverse osmosis to CMSA and building a distribution system to serve these irrigation users. The satellite plant is sized according to the flow available in the nearby sewer main, while the central plant is sized to meet the total entitlement demand in the Peacock Gap area. The costs of these alternatives are presented in Table 6. Siting a satellite treatment plant along Pt. San Pedro Road and blending its effluent with potable water was the most cost effective alternative.

The calculation of $/AF is calculated using both the total acre-feet of water from the entitlement data as well as the estimated use data. The cost of any blending water that may be required is not included in this calculation, so this represents the cost of the new water supply created by the recycled water facilities. For this area, the unit cost for satellite treatment is the same for both entitlement and estimated usage because the capacity of the plant provides less annual acre feet of water than both estimates for water use.

Table 6 Comparative Cost Analysis for Peacock Gap Area

	Alternative	Capital Cost	Annual O&M	Unit Cost $/AF (based on Entitlement)	Unit Cost $/AF (based on Estimated Usage)
1	220,000 gpd Satellite Facility	$4,590,000	$57,000	$3,420	$3,420
2	480,000 gpd upgrade to CMSA (inc. RO)	$13,160,000	$1,048,000	$7,624	$8,840

Note: The unit costs for the satellite facility are based on total water generated by the plant, which is less than both the entitlement and estimated usage. This results in the same unit cost for both categories.

4.6.6 Implementation Considerations

The assumptions of sewer flow and wastewater quality were made based on land use and topography, not by flow monitoring or testing. These assumptions should be verified before considering the construction of a satellite plant. The delivered water cost of $3,420/AF is approximately $1,895/AF more than the next increment of potable water supply through desalination.

4.7 Ross Valley Sanitary District

4.7.1 Summary Market Analysis

The Ross Valley Sanitary District (Sanitary District #1) serves the areas of Bon Air, Fairfax, Greenbrae, Larkspur, Kentfield, Kent Woodlands, Murray Park, Ross, San Anselmo, Sleepy Hollow and Oak Manor. The large recycled water candidates are clustered around Sir Francis Drake Blvd. in San Anselmo. There are 13 identified irrigation users along Sir Francis Drake Blvd. that could be potentially served by a satellite treatment plant. In addition to these users, Mt. Tam Cemetery is a large water user

that is close enough to the Sir Francis Drake users to be included in this cluster. The candidate users are listed in Table 7 and their location is shown in Figure 6.

Table 7 Water Use in the Sir Francis Drake Area of San Anselmo

Customer	Entitlement (AF/yr)	Average Use (AF/yr)
Town Of San Anselmo	1.62	0.53
Union HS Dist Tamalpais	0.02	0.02
Union HS Dist Tamalpais	1.18	0.17
Town Of San Anselmo	0.29	0.29
Tamalpais Union HS Dist	44.93	16.10
Union HS Dist Tamalpais	0.36	0.65
Town Of San Anselmo	9.18	9.18
Sunny Hills Children's Service	9.23	6.06
Ross Valley	4.65	0.49
Donald M Arntz	7.35	1.22
San Anselmo	1.49	0.39
San Anselmo	1.32	1.32
Redhill Fastbreak 76	0.63	0.38
Mt Tam Cemetery	33.51	33.51
Total	**115.76**	**70.31**

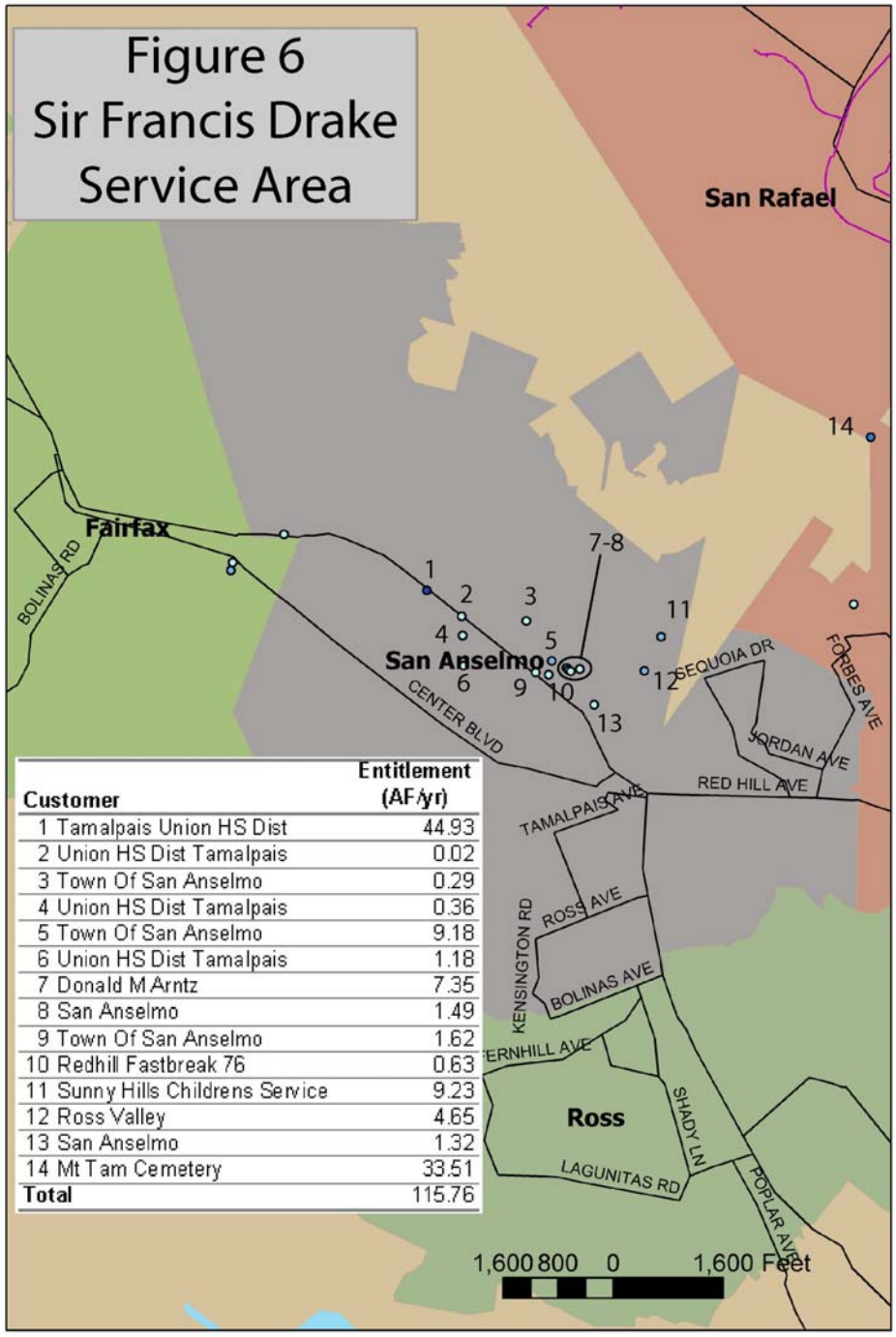
4.7.2 Sizing of Treatment Facilities

Many users in this service area, most notably, Sir Francis Drake High School, use significantly less water than their entitlement. The estimated water usage is only 60% of the entitlement. Even though the satellite plant is sized for the full entitlement, if this alternative were to advance to predesign, a closer evaluation of the correct sizing criteria would be warranted.

The entitlement demands could be supplied by a 224,000 gpd satellite plant.

4.7.3 Location of Treatment Facilities

The best location for the wastewater diversion for the satellite plant is the sewer main on Center Blvd. at Sycamore Ave. As this sewer main contains flows from all of the town of Fairfax, there is plenty of raw wastewater to supply the satellite plant. This location is approximately 24,000 feet from CMSA, the wastewater treatment plant that serves the area. A distribution system of approximately 3,400 feet of pipe would be required from the satellite plant to serve all of these water users.



Customer	Entitlement (AF/yr)
1 Tamalpais Union HS Dist	44.93
2 Union HS Dist Tamalpais	0.02
3 Town Of San Anselmo	0.29
4 Union HS Dist Tamalpais	0.36
5 Town Of San Anselmo	9.18
6 Union HS Dist Tamalpais	1.18
7 Donald M Arntz	7.35
8 San Anselmo	1.49
9 Town Of San Anselmo	1.62
10 Redhill Fastbreak 76	0.63
11 Sunny Hills Childrens Service	9.23
12 Ross Valley	4.65
13 San Anselmo	1.32
14 Mt Tam Cemetery	33.51
Total	115.76

Figure 6 Sir Francis Drake Service Area

4.7.4 Salt Water Intrusion

The entirety of this sewershed is located above the elevation of concern for salt water intrusion.

4.7.5 Comparative Cost Analysis

This study compared the cost of a 224,000 gpd satellite facility with the cost of adding recycled water facilities to CMSA and building a distribution system to serve these water users. Reverse osmosis is assumed to be required at CMSA to manage the salinity. The costs of these alternatives are presented in Table 8. The satellite plant and distribution system was the most cost effective alternative.

Table 8 Comparative Cost Analysis for Sir Francis Drake Area

	Alternative	Capital Cost	Annual O&M	Unit Cost $/AF (based on Entitlement)	Unit Cost $/AF (based on Estimated Usage)
1	224,000 gpd Satellite Facility	$4,770,000	$71,000	$3,600	$5,950
2	224,000 gpd upgrade to CMSA (inc. RO)	$8,550,000	$514,000	$9,370	$12,290

4.7.6 Implementation Considerations

The assumptions of sewer flow and wastewater quality were made based on land use and topography, not by flow monitoring or testing. These assumptions should be verified before considering the construction of a satellite plant. The delivered water cost of $3,600/AF based on entitlement or $5,950/AF based on estimated usage are, respectively approximately $2,075/AF and $4,425AF more than the next increment of potable water supply through desalination.

4.8 Las Gallinas Valley Sanitary District

4.8.1 Summary Market Analysis

MMWD has a recycled water facility adjacent to the Las Gallinas facility with an extensive recycled water distribution system. The analysis in this study identified the Hamilton Fields area of Novato as an area that may feasibly be served by the Las Gallinas recycled water system. The capacity of the existing MMWD 2-mgd recycled water plant is already fully utilized serving current peak summery day demands so expansion of the recycled water facility would be required to serve the Hamilton Fields area. Since this area is in the North Marin Water District service area, it will be discussed in TM #4.

Section 5 Results of Site Visits

The RMC project team conducted a “windshield tour” with Ken Feil of MMWD of the two satellite plants with the lowest cost, the Sir Frances Drake/Mt. Tam Cemetery area, and the Peacock Gap area to determine the feasibility of siting a satellite plant.

5.1 Sir Francis Drake/Mt. Tam Cemetery

There is a large area of land behind the Redhill Shopping Center that may feasibly be used to house a satellite treatment plant and associated storage. Currently there are some ball fields and a preschool in the general area, with many square feet of available, unused land. It is about 2,000 feet from the location of the sewer diversion (the large sewer main in the area goes down Center Blvd), so a small pump station would be required to divert the flow to the location of the plant and another pipe would be required to convey sludge back to the collection system. Another possibility for siting the plant would be to purchase some unused land along the south end of Mt. Tam Cemetery, this would also require pumping from the sewer diversion location. The locations are shown in Figure 7.

One of the largest obstacles to constructing a satellite plant in the area would be serving Mt. Tam Cemetery. The Cemetery's current service connection to MMWD is at its northernmost (and highest elevation) point, furthest from the proposed plant. It is anticipated that the recycled water pipeline that serves the cemetery would have to go all the way to the cemetery's current service connection in order to minimize affect on the existing irrigation system.

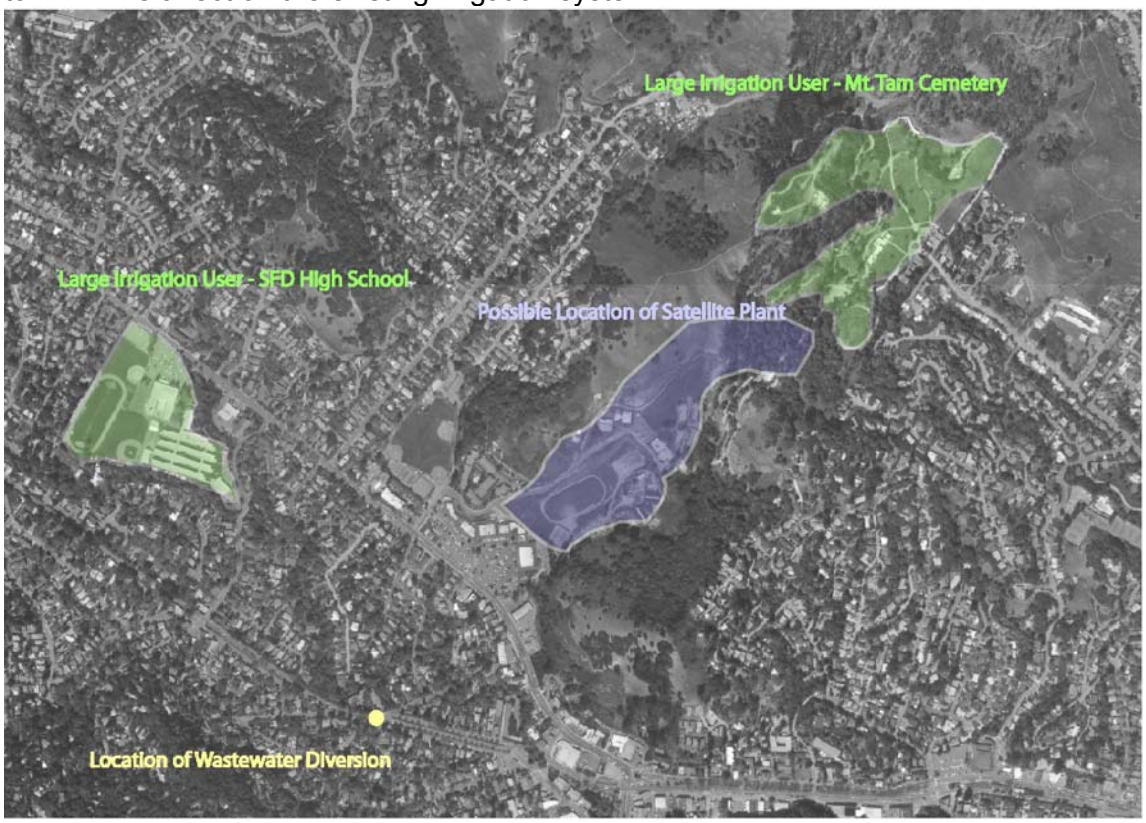


Figure 7 Proposed Location – Sir Francis Drake/Mt Tam Cemetery

5.2 Peacock Gap

The most feasible location for siting a satellite plant in Peacock Gap is the location of the old brick factory off of Pt. San Pedro Rd. This location, while thousands of feet away from both the location of the wastewater diversion and the location of the recycled water users, seems to be the closest area of less-developed, flat land that could house the satellite plant and associated storage. Again, a small pump station would be required for pumping the wastewater from the point of diversion to the satellite plant and another pipe would be required to convey sludge back to the collection system. The location of the proposed facilities is shown in figure 8.

Figure 8 Proposed Location – Peacock Gap

Section 6 Conclusions & Recommendations

The General Criteria in TM #1 suggested that a 4-mile distance from the central plant could result in a cost effective satellite plant as compared to a centralized recycling facility. This local analysis used a 2.5-mile radius to locate potential customers over 4 miles distant from the central plant. A 1-mile radius was used when reverse osmosis was required at the central plant. This proved to be a reasonable method to approximate the actual length of pipeline in public roads.

The customer clusters considered included:

- The Mill Valley Golf Course in the City of Mill Valley's collection system, ultimately tributary to SASM.
- Irrigation at the Peacock Gap Golf Course in the City of San Rafael's collection system, ultimately tributary to CMSA.
- Irrigation along Sir Francis Drake Blvd. in San Anselmo and Mt Tam Cemetery in San Rafael, ultimately tributary to CMSA.

In all three cases the satellite facility was more cost effective than providing recycled water from a centralized facility. The Mill Valley Golf Course case is discussed below.

Satellite water recycling facilities are also under consideration at Fort Baker in the Sausalito-Marin City Sanitary District. That study effort was reviewed but not independently verified as part of this effort.

Because the satellite facilities are most cost-effective at the "edge" of a service area, available sewer flows can be limiting.

The Mill Valley Golf Course irrigation site is relatively close to SASM's central plant. The demand presented by the golf course requires a reasonably-sized sewershed in order to collect adequate flow. This combination of circumstances resulted in a wastewater collection point in very close proximity to the central plant. In this case, pipeline costs resulted in very high satellite plant costs. In other areas, particularly the Peacock Gap area, the full customer demand cannot be served from available, reliable wastewater flows in the sewershed.

Blending with potable water is less expensive than reverse osmosis as a way to manage potential salt effects in recycled water.

Currently, SASM blends potable water with recycled water to reduce salt loading. Expanding this practice within the SASM service area to serve the customers identified in this study is more cost-effective than adding reverse osmosis to expand recycled water service in Mill Valley. However, both alternatives are more expensive than the next increment of potable water supply through desalination.

Generally, while moving to the edge of the water and sewer service area provides some relief from known salt water intrusion problems, there is less available data on wastewater quality. SASM indicates that their need for blending begins when tide elevations reach 6.0. A review of the collection system elevations in the Peacock Gap area suggest that portions of this collection system may be affected by tides. If a recycled water project was implemented, blending with potable water, ideally through an air-gap at a Golf Course pond, could provide more potentially available supply and mitigate salt effects.

This study shows higher costs for satellite treatment than did previous studies

The Review of Water Recycling and Gray Water study done for MMWD in April 2001 by Bahman Sheikh in association with Parsons, showed much more favorable costs and demands for satellite treatment and delivery of recycled water than . Based on the detailed cost estimates provided in Appendix A of the report, the following reasons for these disparities are proposed:

- In the 2001 report, recycled water demands seem to be based on land use assumptions as opposed to actual entitlement and water use data. This resulted in larger proposed satellite plants. These plants would have a smaller unit cost due to economies of scale.
- The 2001 report included many large water users that have been determined in this analysis to be more cost effectively served by central recycled water treatment.
- The 2001 report did not include allowances for the satellite plant needing a pump station and force main to divert wastewater to the satellite plant. The analysis for this TM included situations in which the raw wastewater will need to be pumped large distances to feed the satellite plant.
- The 2001 report did not include cost allowances for architectural treatments that would be needed in an urban setting.
- It has been three years since the former report was written, and construction costs have gone up considerably in that amount of time.

The satellite treatment facilities have higher unit costs than the next increment of potable water as a stand-alone water supply.

Table 9, below, outlines the estimated cost per acre-foot of water from each of the clusters under study and compares these to the estimated cost per acre-foot of water from MMWD's proposed desalination plant.

Table 9 Overall Cost Comparison

Satellite Location	Unit Cost $/AF (based on Entitlement)	Unit Cost $/AF (based on Estimated Usage)
Mill Valley Golf Course	$6,140	$6,470
Peacock Gap	$3,420	$3,420
Sir Francis Drake – San Anselmo	$3,600	$5,950
Potable Service	**$/AF**	**$/AF**
Desalination – next increment of water supply	$1,525	$1,525

Based on evaluation of recycled water as a new water supply, satellite treatment plants do not appear to be a cost-effective alternative to the new desalination supply proposed by MMWD. Further study of satellite plants as an alternative water supply within the MMWD service area is therefore not recommended.

If other driving forces for expansion of the recycled water supply emerge in the future, such as a need to reduce wastewater discharge due to new regulations, further studies should include the following:

- Verification of water demands and available wastewater flow within the sewershed
- Environmental documentation
- Refinement of costs including land acquisition, engineering studies and design
- Financing plan
- Development of inter-agency agreements for operation and maintenance of the facilities